Chapter 4
Governors

4-1. General

The design of governors for turbines and pump-turbines is specified as a responsibility of the governor manufacturer. In general, the governor operating requirements and characteristics will be determined from the electrical, mechanical, and hydraulic characteristics of the generator, turbine, and penstock. Guide Specification CW-16252 provides the basis for preparing specifications. EM 1110-2-3006 provides guidance for the electrical and electronic controls of the governor. Coverage in this chapter includes considerations pertinent to selecting the guide specifications mechanical options.

4-2. Considerations

a. System pressures. The nominal pressure of governor-servomotor systems is selected from a series of standard pressures ranging from 2,067-6,890 kPa (300-1,000 psi). Turbine requirements will usually indicate the desirable nominal pressure (refer to paragraph 2-2*o*). Since turbine contracts are normally scheduled in advance of governor contracts, the nominal pressure will have been determined before the governor specification is prepared. However, it is important to exchange information with potential governor suppliers during preparation of the turbine specification. The working pressure range should be appropriate for the nominal system pressure as indicated in the guide specification. The differential pressure across gate servomotor ports (and oil head ports of Kaplan units) is assumed 80 percent of the minimum working pressure range for figuring servomotor capacity. This assumed value allows for piping and valve losses and requires that the governor and turbine contractors cooperate to limit the pressure drop in the system accordingly. System design pressure should be at the pressure tank valve setting which is normally 110 percent of nominal system pressure.

b. Oil heaters. The minimum and maximum design ambient temperatures should be the heating and ventilating system design temperatures for the room with allowance for nonuniform temperature conditions in the room. The minimum ambient temperature stated may be of significance to the governor contractor in determining the need for oil heaters if oil of higher viscosity than standard turbine oil will be used in the governor system. If oil heaters are used, care must be taken to ensure that the surface temperature of the oil heater does not cause any chemical change of the oil, such as chemical breakdown.

c. Pressure tank.

(1) Location. The powerhouse equipment layout should provide the pressure tank location(s) with the shortest and most direct lines practicable from the tank to the actuator and servomotors in order to minimize pressure losses.

(2) Tank design and pressure. The tank and safety valve shall be designed in accordance with the latest version of the American Society of Mechanical Engineers (ASME) “Boiler and Pressure Vessel Code.” The tank design pressure should be a minimum of 115 percent of the maximum system operating pressure. This will allow for variations in the pump stop switch and oil pump pressure relief valve and safety valve blowdown pressure. A pilot-operated ASME safety valve should be used which has a 98 percent cracking pressure and a 4 percent blowdown. The safety valve setting should never exceed the stamped tank pressure rating but should be equal to or less than the stamped tank pressure rating. An example is as follows:

Stamped Tank Pressure	4,795 kPa (696 psi)
Stamped Safety Valve Setting	4,168 kPa (605 psi)
Safety Valve Cracking Pressure	4,086 kPa (593 psi)
Safety Valve Blowdown Pressure	3,996 kPa (580 psi)
Oil Pump Pressure Relief Setting	3,962 kPa (575 psi)
Governor Oil Pump High-Pressure Stop Switch (Maximum system operating pressure) . . .	3,790 kPa (550 psi)

(3) Tank test pressure. Shop test pressure should be in accordance with the ASME “Boiler and Pressure Vessel Code.” This is typically 150 percent of the stamped tank pressure.

(4) Tank height. A specification restriction on tank height should be avoided unless required by powerhouse structural configuration.

(5) Tank oil level alarms. High and low oil level alarms will normally be required to permit monitoring of pressure tank and sump tank oil level in the control room.

In addition, pressure tank high-level and sump tank low-level contacts are used for pump control to stop the pump and lock it out in case of pump unloader valve failure.

d. Distributing valve adjustment. The required setting for the wicket gate opening or closing rate is dependent on the design for maximum unit overspeed and the water hammer design stresses in the penstock and turbine. The timing usually stated in the specifications is between 8 and 20 sec. For turbine blade adjustment, a rapid response is not required and can impose undesirable stresses in the blade operating mechanism. Then the timing usually stated in the specification is between 20 and 60 sec.

e. Maximum runaway speed. The maximum runaway speed to be specified should be based on the turbine model test results.

f. Brake air valve. The air pressure for the brake air valve should normally be specified at a nominal 689 kPa (100 psi). If there is reason to expect the station service air will be controlled to a higher pressure, the powerhouse construction contract should require a pressure-reducing valve in the brake system air supply. If the turbine runner is below minimum tailwater elevation, a timer to effect intermittent operation of the brake air valve is seldom justified as satisfactory operation is normally possible by allowing the unit to decrease to 30 percent speed with no brake application, then apply brakes continuously.